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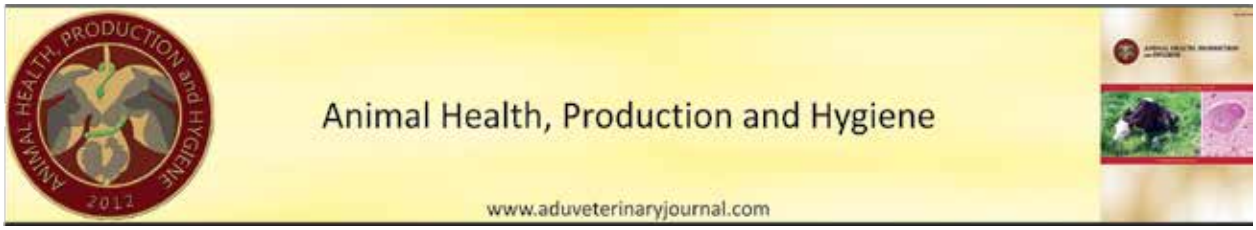

Research Article

Understanding Primary and Secondary Skin Lesions among Infectious Dermatoses in Dogs: Lessons We Learned from Cases

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A B S T R A C T

Dermatological diseases in dogs are one of the most common problems observed among small animal veterinary practice. Recent clinical research has led to marked advances in understanding, including the recognition that a wide spectrum of clinical severity exists and that utility and comments of skin lesions are significantly more complex than originally thought. The present article addresses some of the most common clinical questions relevant to canine dermatology cases and scenarios surrounding it, with the hope to convey the improved understanding and the condition's wide spectrum of complexity learned from cases observed within the last 10 years cared. The medical records and clinical, dermatological and microbiological signs along with accompanying available laboratory findings of 86 dogs diagnosed with various infectious dermatoses with primary and/or secondary skin lesions were reviewed in an attempt to elucidate the etiology. Available retrospective records were evaluated for information on dermatological lesion appearence, and if possible clinical analyte abnormalities. A methodological series of diagnostic tests included physical and dermatological examinations, deep skin scraping, fecal analysis, microbiological and mycological cultures and IFAT, available. Diagnosis included sarcoptic mange (n=18, group I), dermatophytosis (n=14, group II), malassezia dermatitis (n=14, group III), leishmaniasis (n=12, group IV), demodicosis (n=20, group V), hookworm dermatitis (n=4), pelodera dermatitis (n=2), and cutaneous Neosporosis (n=2). Median alopecia, hyperpgimentation and lichenification scores showed no significant changes among the infectious dermatoses groups, whereas median crusting, scaling and comedo scores presented a statistically significant difference among groups at the level of ($p<0,001$). The present article highlights the importance of evaluating skin lesion characteristics among infectious dermatoses in dogs.

Keywords: Dog, primary, secondary, skin, lesions

Köpeklerde İnfeksiyöz Dermatozlarda Primer ve Sekonder Deri Lezyonlarını Anlamak: Olgulardan Edindiğimiz Dersler

ÖZET

Dermatolojik hastalıklar küçük hayvan veteriner hekimliğinde pratikte en sık gözlemlenen problemlerden birisidir. Son yıllardaki klinik araştırmalarla, geniş spekturumda farklı derecelerde klinik bulguların şekillendiğinin anlaşılmasıyla deri lezyonlarının özellikleri ve yorumlanmasının aslında düşünülenden daha da kompleks olduğu tespit edilmiştir. Bu araştırma makalesinde köpeklerde sıklıkla karşılaşılan dermatolojik problemlere ve bu çerçevede oluşan olgu akışına işaret edilirken, son 10 yılda karşılaşılan vakaların karmaşıklığı ve klinik bulguların geniş yelpazede seyrinin daha iyi anlaşılabilmesine katkı sağlanabileceği düşünülmüştür. Primer ve/veya sekonder deri lezyonu gösteren, çeşitli infeksiyöz dermatolojik bozukluğa sahip 86 köpekte mümkün olan medikal kayıt, klinik, dermatolojik ve mikrobiyolojik bulgular etiyolojik değerlendirilme amacıyla derlendi. Eldeki retrospektif kayıtlar doğrultusunda dermatolojik lezyonun görünümü, ve mümkünse klinik analiz sonuçları değerlendirildi. Metodolojik olarak uygulanan diyagnostik testler; fiziksel ve dermatolojik muayene bulguları, derin deri kazıntısı, dışkı tahlili, mikrobiyolojik ve mikolojik kültür ve olası IFAT sonuçlarıydı. Sarkoptik uyuz (n=18, I. grup), dermatofitozis (n=14, II. grup), malassezia dermatitis (n=14, III. grup), leishmaniazis (n=12, IV. grup), demodikozis (n=20, V. grup), kancalı kurt dermatitis (n=4), pelodera dermatitis (n=2) ve kutanöz neosporozis (n=2) tanısı konulan olgular çalışmaya dahil edildi. Gruplar arasında ortanca alopesi, hiperpigmentasyon ve likhenifikasyon skorları istatiksel açıdan farklılık göstermezken, ortanca kabuklanma, kepeklenme ve komedon skorlarının gruplar arasında $p<0,001$ düzeyinde istatistiksel önem arz ettiği belirlendi. Bu makale köpeklerde infeksiyöz dermatozlarda deri lezyonlarının değerlendirilmesinin önemini vurgulamaktadır.

Anahtar Kelimeler: Köpek, primer, sekonder, deri, lezyonları

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Introduction

Most often the veterinary clinicians are not presented with a canine case in the early stages of skin disease, although the disease has been present for a while (Harvey, 2008). In addition the morphologic characteristics of skin lesions along with history, are essential aspects of dermatological diagnosis (Alhaidari, 1988; Scott, 1981). Even in case of lacking laboratory analysis, macroscopic appearence and the medical/dermatological history are simply the solely guidelines (Scott et al., 2001). Therefore the veterinary clinican should have to learn how to handle or recognize primary and secondary lesions (Scott et al., 2001; Harvey, 2008). Primary skin lesions (macule, papule, pustule, vesicle, wheal, nodule or tumor) (Scott et al., 2001; Harvey, 2008), are initial eruptions occuring spontaneously via direct reflection of underlying condition, and appear rapidly and may disappear quickly (Scott et al., 2001). Some of the lesions may be primary or secondary such as alopecia, scale, crust, follicular cast, comedo and pigmentary abnormalities (hyperpigmentation/hypopigmentation). Secondary skin lesions (epidermal collarette, scar, excoriation, erosion/ulcer, fissure, lichenification and callus) grow from primary lesions or may be induced by the case itself or by external conditions (Scott et al., 2001). In summary especially identification and recognition of the aspects of both primary and secondary lesions must be taken into consideration in the diagnosis of skin diseases (Scott et al., 2001; Harvey, 2008).

The present author's interest partially on primary and secondary lesions in dogs was aroused following analysis of various dermatologic case records for several years. At that time various numbers of dogs of both sexes, from various breeds and ages, had been admitted to the Department of Internal Medicine, Faculty of Veterinary, Adnan Menderes University for complaints of various dermatologic problems, some of which had been treated by the referring veterinarians with no response to various medications. Of those animals, most of them had same complaints of localized/generalized alopecia and hyperpigmentation. Apart from those aforementioned lesions, other primary and secondary lesions were also evident among cases. Therefore the present authors began analysing aforimentioned clinical symptoms.

The purpose of the survey was to present etiopathological researches and to addresses primary and secondary skin lesions relevant to canine dermatology and scenarios surrounding several clinical cases, with the hope to convey the improved understanding and the condition's wide spectrum of complexity learned from cases observed within the last 10 years cared.

Materials and Methods

Case selection criteria

The 86 dogs (n= 47 male and 39 female; aged 5 months to 8 years) studied were referred for investigation of primary (macule, papule, pustule, vesicle, wheal, nodule or tumor) and/or secondary (epidermal collarette, scar, excoriation, erosion/ulcer, fissure and lichenification) skin lesions. Dogs of various breeds, of both sexes, were deemed eligible for enrolment once they satisfied an inclusion criteria. With special reference lesions that may be primary or secondary such as alopecia, hyperpigmentation, crusting, scaling, lichenification and comedo formation were subjected to scoring in all animals involved, as almost all cases commonly present those dermatological signs. Age, sex, breed and the presence of main clinical symptoms of the animals were recorded.

Study design and subjects

Informed written consent was obtained from all of the owners prior to enrolment of the dogs participated in study. The dogs were divided and randomly assigned into 5 major groups. Sarcoptic mange (n=18, group I.), dermatophytosis (n=14, group II.), malassezia dermatitis (n=14, group III.), leishmaniasis (n=12, group IV.), and demodicosis (n=20, group V.). Other dogs were not classfied, nor grouped neither were subjected to scoring as because of insufficient number of dogs as follows; hookworm dermatitis (n=4), cutaneous Neosporosis (n=2) and pelodera dermatitis (n=2).

Scoring of skin lesions

All dogs enrolled in the present study were subjected to scoring for relevant clinical signs (alopecia, hyperpigmentation, crusting, scaling, lichenification and comedo). All animals were clinically scored, similar to scoring obtained for dogs with sarcoptic mange (Deger, 2011) and horses with chorioptic mange (Rendle et al., 2007), for severity of infestation on a scale of 0-3. Blinded clinical dermatological assessments (severity of the lesions) were made for all groups. Clinical evaluation scores were recorded as follows: 0: no clinical signs, 1: mild signs, 2: moderate signs and 3: severe signs. Hyperpigmentation was evaluated within the severity of pigmentation on the lesion by use of macroscopic examination with a grade of 0 (none pigmentation on the skin), 1 (mild hyperpigmentation), 2 (moderate hyperpigmentation) and 3 (severe hyperpigmentation). Alopecia was scored at several body sites according to the severity of lesional skin with a grade of (0 = no hair loss), (1 = %25-50% hair loss), (2= 50-75% hair loss) and (3= >75% hair loss). The level of scaling and lichenification in each case were scored using a grade as 0 (no scaling nor lichenification), 1 (mild scaling or lichenification), 2 (moderate scaling or lichenification in several sites) and 3 (severe scaling or lichenification). Crusting was graded as 0 (none crusting), 1 (mild crusting), 2 (moderate crusting) and 3 (severe crusting). Comedon formation was graded as 0 (no comedones), 1 (mild comedones confined to local sites), 2 (comedones with pustules confined to more than one site) and 3 (severe comedones confined to multifocal sites).

Diagnostic applications

Mycological diagnostic and sampling procedures

Malassezia pachydermatitis (M. pachydermatitis) isolation and identification

The swabs were taken from skin and/or external ear canal of 14 dogs (at the age of 1 to 7 years, examined. The criteria for involvement of the dogs were inflammatory skin lesions (dermatitis), alopecia, hyperpigmentation, seborrhoea (with accompanying specific sweetish odour) and/or otitis (dark brown thick cerumen inside the ear canal). Swab samples for cytology was rolled onto a glass slide and then stained with Wright-Giemsa. Afterwards stained process was examined under microscope at × 40 magnification. At least 10 fields were examined and samples with more than 5 yeasts on average per one field were considered positive. Sabouraud's dextrose agar with chloramphenicol and modified Dixon's agarwere used according to Senczek et al. (1999). Inoculated samples were incubated at 30°C for 5 days and monitored frequently. Identification of *M. pachydermatitis* species was thoroughly based on macroscopic and microscopic appearance of colonies and its ability to grow on the medium (without lipid supplementation). Any sample with a growth of more than 5 colony-forming units per plate was suggested positive.

Microsporum canis (M. canis) isolation and identification

All 14 dogs involved in the present study were referred to Wood's lamp examination and fungal cultures, for diagnosis. All cases were examined under Wood's lamp (in a dark room) and yellowish-green fluorescence indicated the presence of probable dermatophyte infection as reported previously (Ural et al., 2009). Afterwards hairs that fluoresced were cleaned with cotton soaked in 70% alcohol and then withdrawn by the help of a hemostat. All obtained samples were treated with 20% potassium hydroxide for 30 min incubation, followed by observation under a light microscope at 40× magnification. Samples were incubated onto Sabouraud's dextrose agar medium within 3 weeks incubation at 25 °C and 37 °C under aerobic conditions.

Parasitological diagnostic and sampling procedures

Dermatological examination technique for demonstrating mites

Demodectic mange

Dermatological examination techniques for demonstration of probable mites in the present study consisted of hair-plucking examination technique and tape preparation technique. The acetate tape was performed in an attempt to investigate short bodied *Demodex canis* (*D. canis*) mites. The sticky surface of the acetate tape was firmly pressed onto the lesional parts in an attempt to collect the superficial short bodied Demodex mites. Afterwards the tape was mounted directly onto a glass slide (no added mounting medium), followed by examination for the demodectic mites under microscopes with x 400 and 1000 magnification. Species identification of Demodex mites was based on clinical signs and examination of sizes and morphology of the mites as reported previously (Karakurum et al., 2007; Scott et al., 2001).

Sarcoptic mange

Assessment of Sarcoptes scabiei (S. scabiei) infestation

For enrollment in the present study dogs had to have existing *S. scabiei* infestation, as assessed by the determination of live mites (larva, nymph and adult) within skin scrapings of at least 3-4 sites. Skin scrapings were performed at those sites with a border to healthy tissues, likely to yield mites and to those of observable suspicious lesions. Hair was removed and then the lesion was scraped till capillary bleeding was occured. The withdrawed scraping material was treated with paraffin liquide and then microscopically examined for live mites, and if necessary the samples were cleared with potassium hydroxide. The data were recorded even if on the presence or absence of live mites.

Serological test for L. infantum

Sera titer of specific anti-Leishmania antibodies was determined within immunofluoresence antibody test (IFAT). The IFAT was performed by use of standard procedures previosuly described. Titres ≥128 were suggested as seropositive (Abranches et al., 1991).

Serological test for Neospora caninum (N. caninum)

Antibodies to *N. caninum* were determined by the indirect immunofluorescent antibody test (i-IFAT) Titres ≥50 were suggested as seropositive (Basso et al., 2001).

Ancylostoma caninum (A. caninum) detection

Direct fecal examination and Fulleborn's fecal flotation were used. Besides cytological examination of pododermatitis lesional sides were performed (Ural et al., 2012).

Pelodera strongyloides detection

Method for the diagnosis of *Pelodera* dermatitis involved skin scrapings. Diagnosis of the present cases was based on clinical history and detection of typical larvae in skin scrapings and the detection of the morphology of larvae as reported previously **(**Saari and Nikander, 2006).

Statistical analysis

The ordinal data subjected to scoring were evaluated within Kruskal-Wallis analysis of variance with post hoc Bonferroni corrected Mann-Whitney U test. Results for ordinal data were given as median values and were deemed statistically significant if *P* values <0.05.

Results

Malassezia dermatitis

Malassezia species were isolated from at least 1 site from all dogs (n=14), at the age of 2 to 7 years of age with breed distribution as follows 4 English Cocker Spaniel, 3 Golden Retriever, 2 Beagle, 1 each Yorkshire Terrier, Irish Setter, Poodle, Miniature Schnauzer and Border Terrier, involved in this group.

Clinical findings

Malassezia dermatitis resulted in clinical signs of alopecia, localized-generalized erythema, erythematous papules/macules, crusts and scaly skin on the facial area (n=4), the trunk (n=1), ear and pinnae (n=3), and perianal and interdigital areas (n=4) (Figures 1, 2).

Figure 1. a) Malassezia dermatitis in ear pinnae of a Golden retriever, resulting with keratoseborrhoeic disorder with hyperpigmentation, scaling, crusting and alopecia and a greasy aspect of skin and hair. **b)** Lichenification and hypermelanosis in a dog with Leishmaniosis and Malessezzia dermatitis.
Şekil 1. a) Golden retriever ırkı köpeğin kulak kepçesinde Malassezia dermatitis sonucu şekillenen keratoseborrheik bozukluğa bağlı hiperpigmentasyon, kepeklenme, kabuklanma ve alopesi ile deri ve kılların yağlı görünümü. **b)** Leishmaniazis ve Malassezia dermatitisle enfekte bir köpekte likenifikasyon ve hipermelanozis.

Figure 2. Interdigital area was involved with alopecia, crusting and Malessezzia dermatitis was proofed on cytology.
Şekil 2. Interdigital alanda sitoloji ile belirlenmiş Malassezia dermatitise bağlı alopesi ve kabuklanma.

Dermatophytosis

M. canis was identified by Wood's lamp examination and fungal cultures from lesions of all dogs (n=14) in the assay group. The dogs were at the age of 7 months to 6 years of age with breed distribution as follows 4 Kangal shepherd dog, 3 Belgain shepherd dog (Malinois), 2 Golden Retriever, 1 Beagle, 1 Dalmatian and 3 mixed breed.

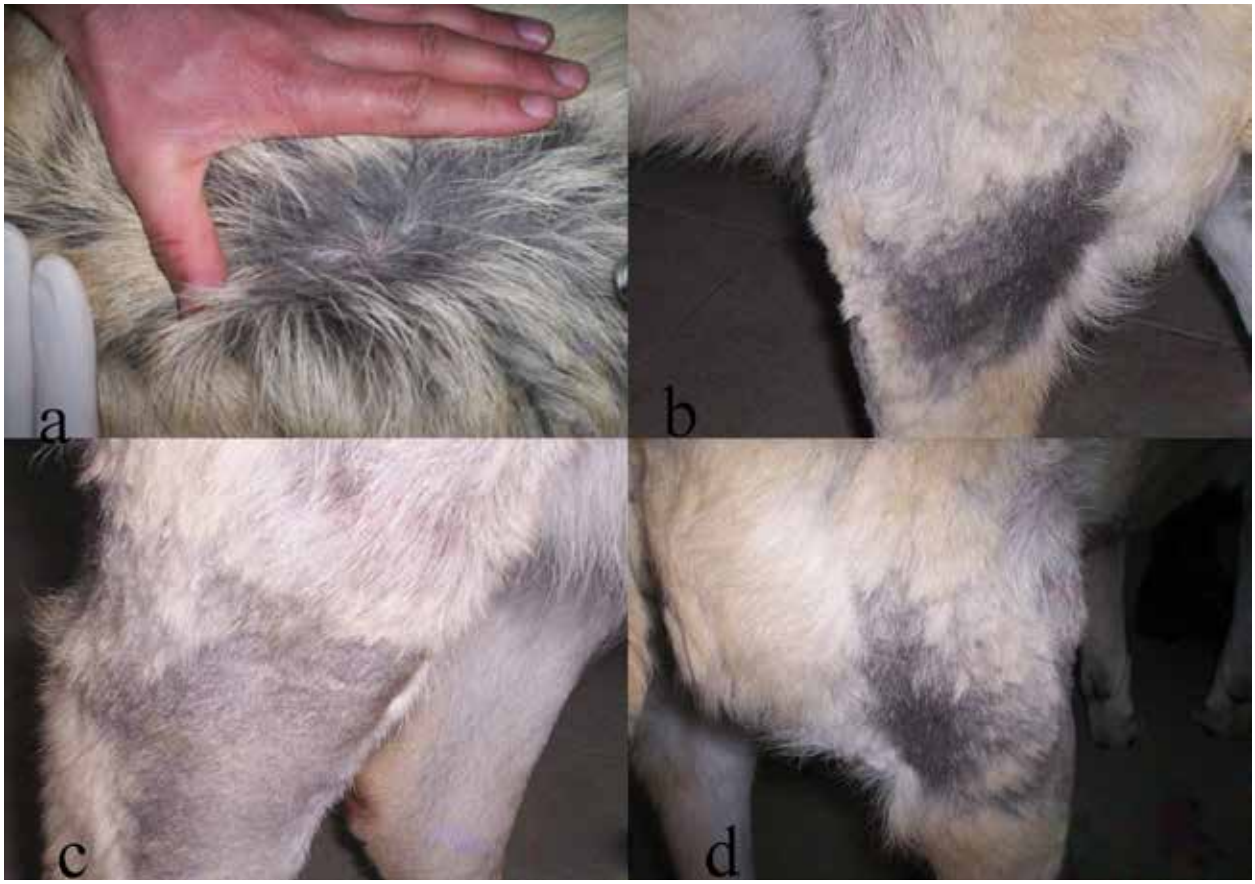

Figure 3. Alopecia and hyperpigmentation in a Kangal dog. **a)** on dorsum, **b)** left lateral aspect of feet, **c)** right genu and **d)** right back, due to dermatophytosis.
Şekil 3. Kangal köpeğinde dermatofitozise bağlı alopesi ve hiperpigmentasyon. **a)** sırt bölgesinde, **b)** ayakta sol lateral görünümde, **c)** sağ genu ve **d)** sağ arka bölgede.

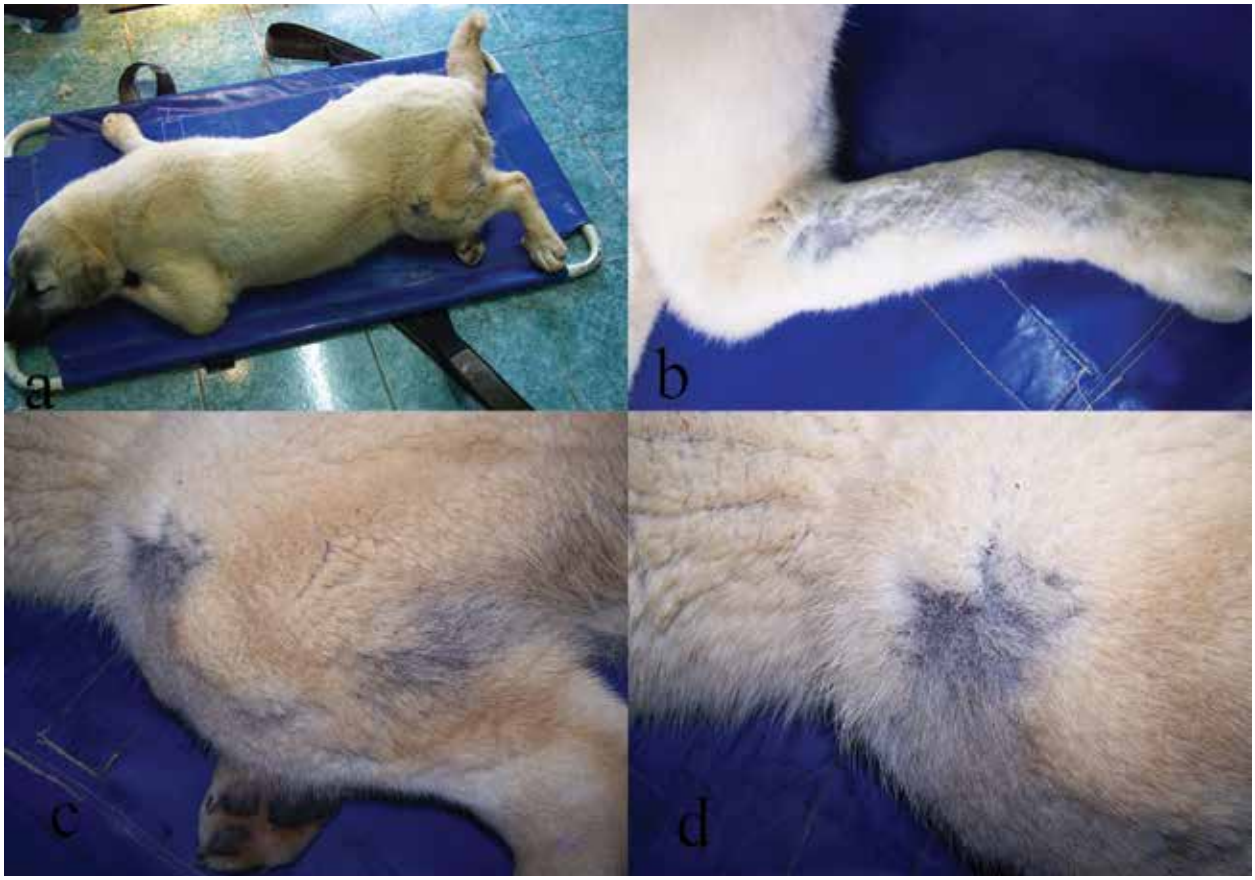

Figure 4. Alopecia as a clinical feature of dermatophytosis in a Turkish shepherd dog in **a)** general view, **b)** front leg, **c-d)** rear leg.
Şekil. 4. Sivas Kangal köpeğinde dermatofitozise bağlı oluşan alopesi **a)** genel görünümde, **b)** ön bacakta, **c-d)** arka bacakta

Clinical findings

Dogs enrolled in the present study presented dermatological inflammatory lesions of peripherally invading alopecia, scale, crusts, hyperpigmentaion, lichenification and or comedones. Lesions were localized on head/face, especially on periocular area (n=5), eye and pinnae (n=3), and they were located in trunk (n=2) and legs (n=2) (Figures 3-6).

Figure 5a-b. Patch, a macule larger than 1cm size, with discoloration of the skin with an increase in melanin pigmentation. The case was a 3 years old Belgian shepherd dog with dermatophytosis.
Şekil 5. Yama, melanin pigmentasyonunun artışı sonucu deride oluşan renk bozukluğuyla karakterize, 1 cm'den daha büyük bir makül. Olgu dermatofitozisli 3 yaşlı Belçika çoban köpeği.

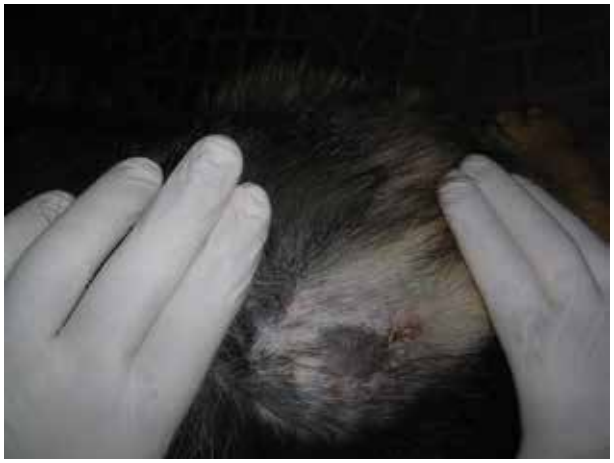

Figure 6. Patch, larger than a macule, in a Labrador retriever dog (photographic record was obtained following skin punch biopsy). Dermatophytosis was the tentative diagnosis following Wood's lamp examination, histopathology and culture.
Şekil 6. Labrador retriever ırkı köpekte makülden daha büyük deri yaması (fotoğraf bölgeden yapılan punch biyopsi sonrasında çekilmiştir). Dermatofitozis, Wood's lamba muayenesi, histopatoloji ve kültür ile birlikte geçici teşhis olarak düşünülmüştür.

Demodectic mange

At the assessment on day 0, microscopic examination of deep skin scrapings (n=20) showed many demodectic adults, nymphs, larvae, and ovae typically found with *D. canis*.

Localization of lesions and clinical examination results

Demodectic mites were recovered from the skin of the leg, head and trunk. Especially ears (n=2), eyes (n=4), lips (lip fold dermatitis n=5), chin (n=3) and legs (with folliculitis; n=6) were involved. Out of 20 dogs (at the age of 8 months to 8 years of age; 7 German Shepherd dog, 3 Labrador, 2 Belgian shepherd dog, 2 Golden Retreiver, 1 each Pointer, French Bulldog, Miniature Schnazuer, Dogo Argentino and 2 mixed breed), 9 had localized demodicosis (typically 1 or 2 focal reddened or hairless areas in one body region) whereas the other 11 had generalized demodicosis (Figures 7-20). Pododemodicosis was a major complaint in most of the dogs with localized demodicosis. (Figures 26 b,c; figure32 c,d)

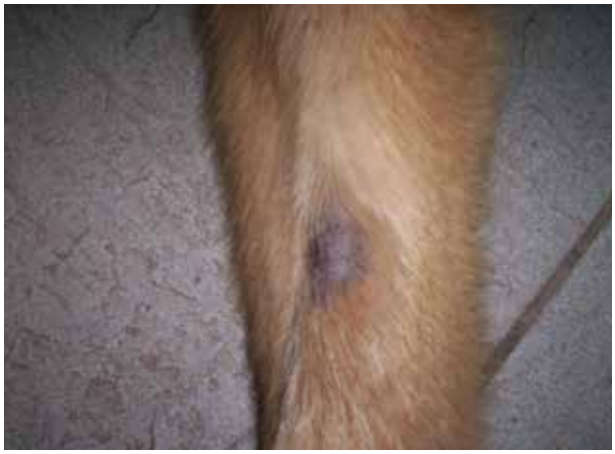

Figure 7. Localized demodicosis in a Belgian Mallineous, folliculitis was evident along with local alopecia.
Şekil 7. Belçika Çoban Köpeğinde lokal demodikozis sonucu oluşan lokal alopesi ile birlikte belirgin folikülitis.

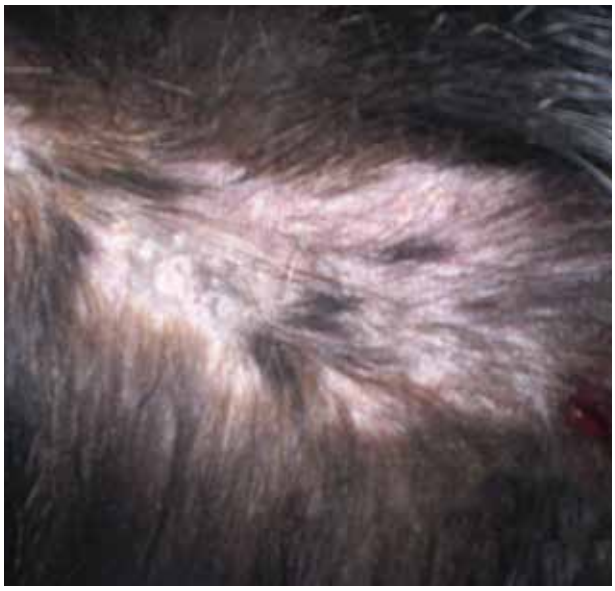

Figure 8. Local alopecia and hyperpigmentation was evident (bleeding due to skin scraping) in relation to demodicosis.
Şekil 8. Demodikozise ilişkin lokal alopesi ve hiperpigmentasyon (kanama kazıntı sonucu oluşmuştur).

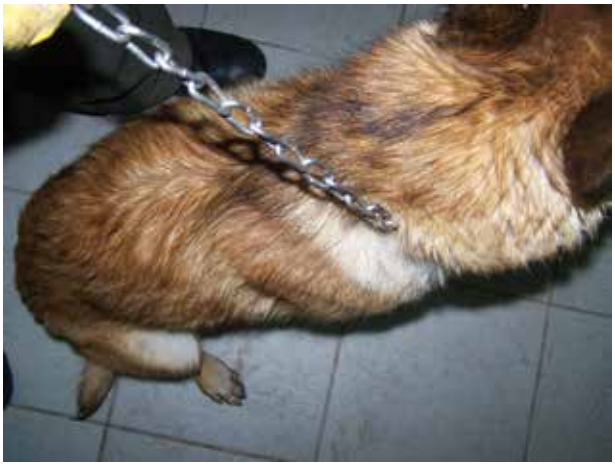

Figure 9. Local alopecia and hyperpigmentation in localized demodicosis.
Şekil 9. Lokalize demodikoziste lokal alopesi ve hiperpigmentasyon.

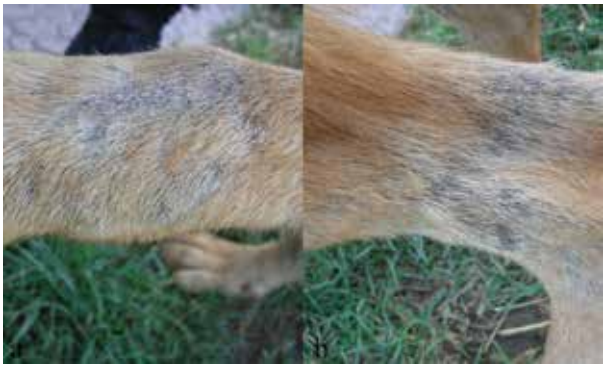

Figure 10. Localized demodicosis in a German shepherd dog on the front and rear feet.
Şekil 10. Alman Çoban Köpeğinde ön ve arka ayakta lokalize demodikozis.

Figure 11. Alopecia, erythematosus dermatological lesions in a Dogo Argentino with solar dermatitis and localized demodicosis.
Şekil 11. Dogo Argentino ırkı köpekte solar dermatitis ve lokalize demodikozis ile ilişkili alopesik ve eritematöz dermatolojik lezyonlar.

Figure 12. Comedone formation along with hyperpgimentation and mild hyperkereatosis in a dog with hypothyroidism and demodicosis.
Şekil 12. Hipotiroidizm ve demodikozisli köpekte hiperpigmentasyonla birlikte komedon oluşumu ve hafif hiperkeratozis.

Figure 13. Localized demodicosis; alopecia were noticed on the periocular area solely.
Şekil 13. Lokalize demodikozis; yalnızca periokuler bölgede gözlenen alopesi.

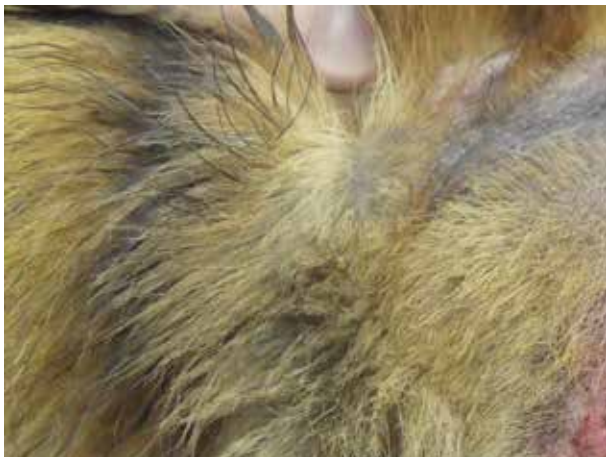

Figure 14. Localized demodicosis characterized within intense pruritus, alopecia, hyperpigmentation, erythema.
Şekil 14. Şiddetli kaşıntı, alopesi, hiperpigmentasyon ve eritemle karekterize lokalize demodikozis.

Figure 15a-b. French Bulldog with a history of wheals due to urticaria. The dog also had had a history of generalized demodicosis and atopia for 2 years duration, unresponsive to therapy applications.
Şekil 15. Fransız Bulldog ırkı bir köpekte ürtiker sonucu oluşan plaklar. Ayrıca iki sene boyunca sağaltıma yanıt vermeyen generalize demodikozis ve atopi geçmişine dair anamnez mevcut.

Figure 16. Scar, an area of fibrous tissue replaced the damaged dermis/subcutaneous tissue following localized demodicosis infection.
Şekil 16. Lokalize demodikozis enfeksiyonu sonucu dermis/subkutanöz dokuda hasara bağlı fibröz doku ile değişen alan, yara izi.

Figure 17. Localized demodicosis and lip-fold dermatitis on the erythematosus membrane.
Şekil 17. Lokalize demodikozis ve eritematöz membran üzerinde dudak kıvrımı dermatitisi.

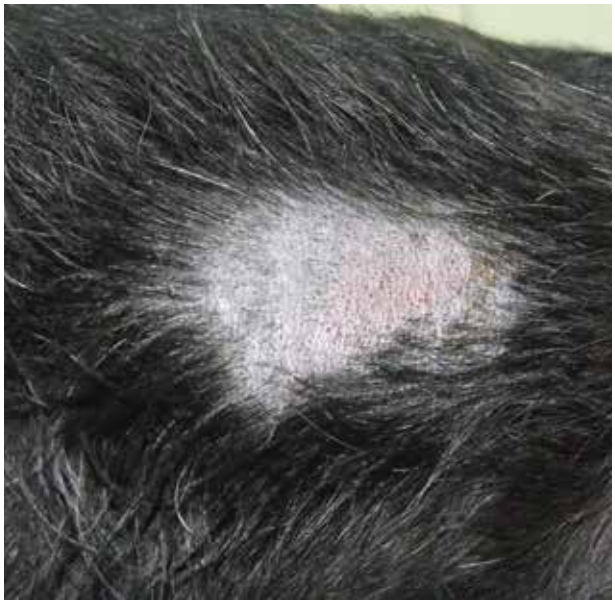

Figure 18. Comedone formation in a Miniature Schnauzer dog. The case also had a history of demodicosis for 2 years duration with waxing and wanning clinical signs.
Şekil 18. Miniature Schnauzer ırkı köpekte komedon oluşumu. Bunun yanıısıra iki seneden beri artan ve azalan klinik bulgularla seyreden demodikozis öyküsü mevcut.

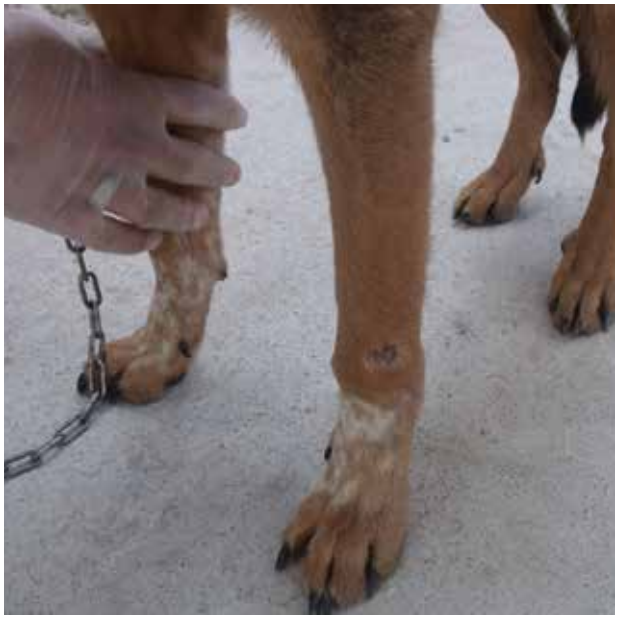

Figure 19.Folliculitis characterized by alopecia and crusting related to localized demodicosis.
Şekil 19. Lokalize demodikozise ilişkin alopesi ve kabuklanmayla karakterize folikülitis.

Figure 20. Localized demodicosis on periorbital area. Notice alopecia and rush (erythema).
Şekil 20. Periorbital bölgede alopesi ve eritem ile karakterize lokalize demodikozis.

Sarcoptic mange

At the assessment on day 0, live mites (adult mites, egg etc.) were recovered from all animals compatible with *S. scabiei*.

Localization of lesions and clinical examination results

A total of 18 dogs (at the age of 5 months to 6 years of age, with breed distribution as follows; 3 Golden Retriever, 2 of each respectively, Siberian Huskey, Germen Shepherd, Boxer, respectively, 1 each Saint Bernard, Samoyed, Rottweiler, English Cocker Spaniel, and 5 mixed breed) were enrolled. Lesion localisations were varaible, determined in every case enrolled. Mild to severe lesions were determined on periocular area (n=4), face/ ears (n=3), chin (n=2), neck, flank, abdominal skin (n=4), and legs (pododermatitis) (n=5). Lesions were observed localised to 1-2 area of the body in some of the cases whereas generalized lesions were observed in others (Figures 21-26).

Figure 21. Hyperkeratosis on the footpads following Sarcoptic mange infection.
Şekil 21. Sarkoptik uyuz enfeksiyonu sonrası patilerde şekillenen hiperkeratoz.

Figure 22. Pododermatitis related to Sarcoptic mange in a crossbreed dog. Alopecia and erythema were noticed.
Şekil 22. Melez köpekte Sarkoptik uyuza ilişkin alopesi ve eritemle karakterize pododermatitis.

Figure 23. Severe scaling, generalized alopecia and prurtius were evident in a stray dog with hypothyrodisim and Sarcoptic mange.
Şekil 23. Hipotiroidizmli ve Sarkoptik uyuzlu sokak köpeğinde şiddetli kepeklenme, generalize alopesi ve kaşıntı.

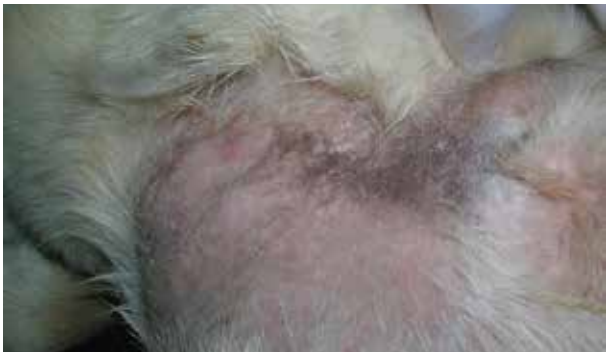

Figure 24. Local alopecia and hyperpigmentation were noticed on the neck of a Golden retriever with Sarcoptic mange.
Şekil 24. Golden retriever ırkı Sarkoptik uyuzlu köpeğin boyun bölgesinde lokal alopesi ve hiperpigmentasyon.

Figure 25. Severe pruritus, alopecia, crusting and finally bleeding were all clinical features of Sarcoptic mange.
Şekil 25. Sarkoptik uyuzun klinik belirtilerinden iddetli kaşıntı, alopesi, kabuklanma ve sonuçta kanama.

Figure 26. a) Sarcoptic mange infestation relevant alopecia, erythema and crusting on the front legs. **b)** Pododemodicosis related alopecia, papulocrustous eruptions with intense pruritus resulting in self-trauma. **c)** Pododemodicosis with partial alopecia, scaling and crusting. Excoriation was also evident as a result of pruritus. **d)** Pododermatitis due to Sarcoptic mange. Notice alopecia and early skin lesions which were characteristic.
Şekil 26. a) Sarkoptik uyuz enfestasyonuna ilişkin ön bacaklarda alopesi, eritem ve kabuklanma. **b)** Pododemodikozise ilişkin alopesi, papülokrustöz erupsiyonlara ilişkin şiddetli kaşınmaya bağlı kendi kendine travma. **c)** Kısmi alopesi, kepeklenme ve kabuklanma ile karakterize pododemodikozis. Şiddetli kaşıntı sonucu ekskoriasyon mevcut. **d)** Sarkoptik uyuza bağlı pododermatitis. Alopesi ve erken deri lezyonları tipiktir.

Serological Test results for Leishmaniasis

All 12 dogs (at the age of 3 to 7 years of age, with breed distribution as follows; 2 of each, German Shepherd, Pointer and Boxer, respectively, 1 each Great Dane, Napoliten Mastiff, Alaskan Malamute, and 3 mixed breed dogs) were found to be positive by IFAT with titers for *L. infantum* varying from 1/128 to 1/512.

Clinical findings

Figure 27. a) Severe hyperpigmentation, alopecia with scaling are prognostic clinical entities of Leishmaniosis. **b)** Leishmania sp. and demodicosis co-infected dog showing alopecia and scaling. **c)** Erosion formation (on testicles) and scarring/healing tissue (on the rear leg) following Leishmaniasis in a Pointer dog. **d)** Leishmaniosis and related signs involving lichenification, hyperpgimentation, alopecia and severe scalling
Şekil 27. a) Leishmaniazise özgü prognostik klinik bulgular; şiddetli hiperpigmentasyon, alopesi ve kabuklanma **b)** Leishmania sp. ve demodikozis ile ko-enfekte bir köpekte alopesi ve kabuklanma **c)** Pointer ırkı köpekte Leishmaniazisi takiben arka ayakta nedbe/iyileşme dokusu ve testis üzerinde erozyon. **d)** Leishmaniazise ilişkin lezyonlar; likenifikasyon, hiperpigmentasyon, alopesi ve şiddetli kabuklanma.

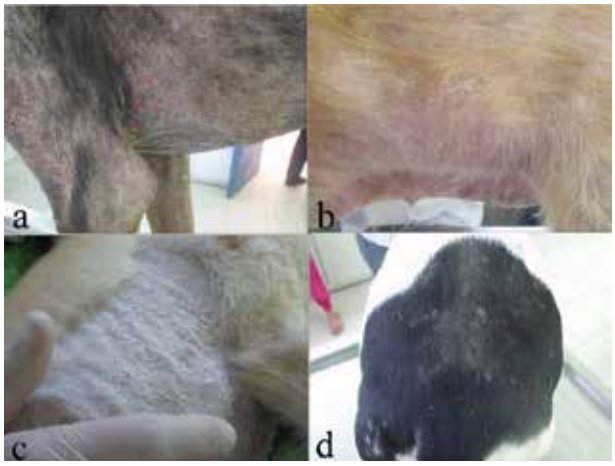

Figure 28. a) Grouped and linear configuration of skin lesions involving crusting, alopecia in a dog coinfected with Leishmaniosis and Sarcoptic mange. **b)** Severe scaling along with alopecia and rash were the initial dermatological signs in this clinical case with a diagnosis of Leishmaniasis **c)** Severe scaling, accumulation of loose fragments of the horny layer among skin. The case was hypothyroidic and *Leishmania sp.* positive within IFAT. **d)** Severe scaling may mimic early clinical aspect of Leishmaniasis as in this case.
Şekil 28. a) Leismaniazis ve Sarkoptik uyuzla ko-enfekte bir köpekte kabuklanma, alopesi ile gruplu ve doğrusal biçimde deri lezyonları. **b)** Leishmaniazis tanısı konulan olguda dermatolojik lezyonların başlangıcı olarak şiddetli kabuklanma, alopesi ve eritematöz döküntüler. **c)** IFAT yöntemiyle Leishmania sp. pozitif olduğu belirlenen hipotiroidli olguda derinin keratinli tabakasındaki kayıplar sonucu oluşan şiddetli kepeklenme. **d)** şiddetli kepeklenme bu olguda da belirlendiği üzere Leishmaniazisin erken klinik bulgusu olabilir.

Non-pruritic generalized exfoliative dermatitis with extensive scaling were evident in all most all cases involved in the present study Silvery white asbestos like scales were noticed(Figures 27-28). Besides 3 of the dogs were coinfected with different infectious agents (*M. pachydermatitis*/Figure 1b, *D. canis*/Figure 27b, and *S. scabiei*/Figure 28a.

Serological Test results for Nesosporosis

A result of 1:50 on the IFAT was positive evidence of *N. caninum* infection in two Pointer dogs, whereas IFAT was negative against *Toxoplasma gondii* for both cases.

Clinical findings

Typically oozing dermatitis from several sites of the body involving trunk and legs were observed. Other than the oozing dermatitis crusting erythematous and alopecic dermatitis were evident, with special reference to pododermatitis (Figures 29, 30, 32b).

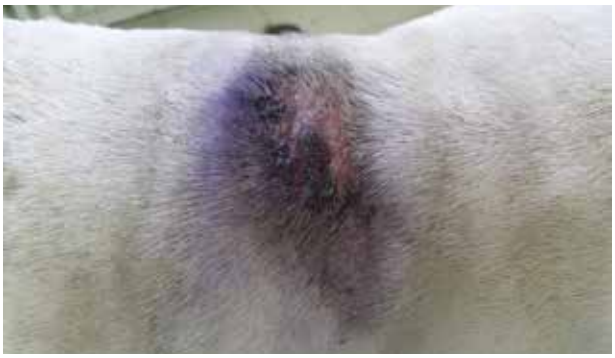

Figure 29. Alopecia, scar formation along with crusting on erythematosus membrane in a Pointer dog with cutaneous Neosporosis. The dog high antibody titer within IFAT against *Neospora caninum*.
Şekil 29. Kutanöz Neosporosisle enfekte Pointer ırkı köpekte alopesi ile birlikte eritematöz membran üzerinde kabuklanma ve nedbe dokusu. IFAT yöntemiyle köpekte *Neospora caninum'*a karşı yüksek oranda antikor titresi tespit edilmiştir.

Figure 30. Serosangineous oozing and related dermatitis in a dog infected with *N. caninum.*
Şekil 30. *N. caninum* ile enfekte bir köpekte dermatitis ve serosanguinöz sızıntı.

Pelodera dermatitis detection

Nematode larvae, compatible with *P. strongyloides* were found in skin scrapings of 2 dogs (German Shepherd and Pointer), with taking into account the differential diagnosis (Figure 31).

Clinical findings

An alopecic, erythematous and crusting dermatitis with pruritus affecting body sites in contact with the ground was typical clinical feature in 2 cases (German Shepherd dog and a Dalmatian). The ventral abdomen, perineum, distal legs, lateral shoulders and lateral thighs were affected. Widespread lesions at the back side of the German shepherd dog was evident.

Figure 31. Pelodera dermatitis in a military German shepherd dog. The rear leg was completeley alopecic, with multiple papulocrustaceous lesions. The case showed fullrecovery following eprinomectin therapy.
Şekil 31. Askeri amaçlı yetiştirilen Alman Çoban Köpeği'nde pelodera dermatitisi. Arka bacağın tamamında birden çok papülokrustöz lezyonla birlikte alopesi. Olgu eprinomektin tedavisinden sonra tamamen iyileşmiştir.

A. caninum detection

In all dogs (at the age of 9 months to 2 years of age, 2 German Shepherd, 1 Belgian Shepherd dog and 1 Mixed breed) the fecal tests revealed *A. caninum* eggs. Cytology revealed few neutrophils in one of the cases, albeit in 2 cases cytological examination of the fecal material collected from the foot pad revealed parasite ova.

Clinical findings

Pododermatitis indicating crusting and erythematous lesions with swelling confined to the footpads in contact with the ground was the typical clinical feature in all cases. Alopecic, erosive to ulcerative lesions at the center of the footpads was also noted (Figures 32a, 33, 34)

Figure 32. a) Early classical lesions of hookworm pododermatitis, along with erythema, alopecia and intense pruritus. **b)** Neosporosis may also result in pododermatitis with fistule formation and oozing dermatitis. **c)** Pododemodicosis resulted within two different lesions along within alopecia both. On the left side pustule formation with erythema was evident, whereas nodule was noticed adjucently. **d)** Classical pododemodicosis compatible with alopecia, petechial lesions and excoriation.
Şekil 32. a) Kancalı kurt pododermatitisine ilişkin eritem, alopesi ve şiddetli kaşıntı ile seyreden erken tipik lezyonlar. **b)** Neosporosis'de de fistül oluşumu ve sızıntılı dermatitisle birlikte bir pododermatitis oluşabilir. **c)** Pododemodikozis sonucu alopesinin olduğu iki farklı lezyon. Sol tarafta eritemle beraber pustül oluşumu; hemen yanında ise nodül. **d)** Alopesi, peteşiyel lezyonlar ve doku kaybı ile uyumlu tipik pododemodikozis.

Figure 33. Hookworm dermatitis due to penetrating *A. caninum* larvae. **a)** fecal material involved at the footpads in contact with the gorund is the major reason. **b)** alopecia, demarcation with tissue destruction, erythema and sweling were evident. **c)** alopecia, eythematous excoriation after penetrating *A. caninum* larvae infection. **d)** 3 months later 1 month/weekly topical eprinomectin therapy, complete recovery with no scar was evident at the same footpads shown in Figure b.
Şekil 33. *A. caninum* larvalarının doku penetrasyonu sonucu kancalı kurt dermatitisi oluşurmu. **a)** dışkı ile bulaşık ayak tabanlarının yerle teması en önemli nedendir. **b)** alopesi, sınırlı bir doku yıkımlanmasıyla birlikte demarkasyon, eritem ve ödem belirgindir. **c)** *A. caninum* larva enfestasyonu sonrası alopesi ve eritematöz doku kaybı. **d)** 1 ay boyunca haftalık topikal eprinomektin sağaltımından 3 ay sonra, Şekil b'deki aynı ayak tabanlarında herhangi bir yara izi kalmadan tam bir iyileşme sağlandığı gösterilmektedir.

Figure 34. Hookworm dermatitis related to *A. caninum* larvae penetration. Paws were also affected within central demarcation, alopecia, pustule formation at the center of footpads in an adult German shepherd dog with the history of residing in a soil contact environment.
Şekil 34. *A. caninum* larvalarının penetrasyonu sonucu oluşan kancalı kurt pododermatitisi. Toprak ile temas ederek yaşayan yetişkin bir Alman Çoban Köpeği'nde ayak tabanlarında merkezi demarkasyon, alopesi ve pustül oluşumu.

Scoring results over the study period

Primary and secondary skin lesions and relevant scores were presented as median values (Table 1). Taking into account scoring results belonging to different infectious dermatoses groups involved, median alopecia, hyperpigmentation and lichenification scores showed no significant changes. Between demodectic mange group and other groups, median crusting scores presented a statistically significant difference (p<0,001). Median scaling scores showed statistically significant differences among groups (p<0,001), albeit the highest score was obtained in Leishmania (IV.) group (Table 1). Median scores for comedo formation indicated statistical variances between Demodectic mange and all other groups at the level of p<0,001 (Table 1). Interestingly median alopecia and hyperpigmentation scores did not differ between groups, as all two dermatological signs were evident in all of the cases.

Discussion

The pathogenesis of Malassezia dermatitis remains mysterious (Gross et al 2005). Alterations in host defense mechanisms, besides skin surface microclimate predispose the microorgqanism becoming a facultative pathogen. Therefore intensive sebum producing, moist accumulation and finally distruption of normal epithelial function may all contribute to yeast inflammation (Mason & Evans, 1991). Probably most common initial clinical signs in dogs are erythema, scaling, crusting and alopecia (Gross et al., 2005). Localized lesions appear as macules and site predilections involve neck, abdomen, face, pinnae, axillar and feet. In the present study entrance of the ear canal, as reported previously (Gross et al., 2005) were most commonly affected among dogs involved.

Pruritis may be the prime clinical sign of canine sarcoptic mange (Gross et al., 2005, Pin et al., 2006). In general erythematous maculopapular eruption along with alopecia and crusting may be noticed. Severe alopecia, lichenification and hyperpigmentation may be observed in chronic phase (Gross et al., 2005; Pin et al., 2006; Feather et al., 2010). The margins of the pinnae are frequently affected in young dogs, as was also noticed in the present studies (Pin et al., 2006; Feather et al., 2010). Most of the dogs involved herein were referred to the clinic at later stages of the infection through with chronicity therefore alopecia, lichenification and hyperpigmentation were evident.

Hookworm dermatitis is relatively uncommon/rare skin disease along with larval migration of *A. caninum*, *Ancylostoma braziliense* and *Uncinaria sterocephala* in dogs (Gross et al., 2005). Third stage larva enters the skin with the soil-contact areas such as distal extremities (Baker & Grimes, 1970; Baker, 1981). Clinical signs appearing include erythematous papules, erythema-swelling (Ural et al., 2012) as initial lesions followed by lichenification and alopecia (Baker&Grimes, 1970; Baker, 1981; Gross et al., 2005) and pododermatitis (Ural et al., 2012). In the present study among dogs enrolled all 4 had pododermatitis with erythematous and alopecic lesions. Tissue destruction was the prominent feature at the footpads in contact with the ground.

Leishmaniasis is a chronic visceral and cutaneous, infectious protozoon disease with insect transmission occurring worldwide (Slappendel, 1988). Obligatory intracellular protozoan from Leishmania genus are transmitted within sandflies. Canine Leishmaniasis has generally been nominated as visceral leishmaniasis as the causative agent, *L. infantum* is responsible for visceral Leishmaniasis in people (Slappendel & Ferrer, 1998). Indeed this syndrome observed among dogs is almost a combination of cutaneous and visceral disease (Gross et al., 2005). Typical manifestation involve a non-puritic, exfoliative dermatitis with accompanying alopecia. Clasically silvery-white asbestos-like adherent scaling may be a prominent sign (Ferrer et al., 1988; Ferrer, 2002; Gross et al, 2005). Generalized noduler skin disease (Slappendel & Ferrer, 1998), onchogryphosis (Ciaramella et al., 1997; Koutinas at al, 1999) may be observed and muzzle, pinnal and periorbital regions are severely affected (Gross et al, 2005). Periorbital alopecic rings (lunettes) and scalling and depigmentation of planum nasale muzzle may be detected (Gross et al., 2005). In the present study as an initial sign of the disease scaling was frequently observed in all of the dogs involved followed by alopecia and hyperpigmentation as major clinical features. Besides the highest score was obtained in Leishmania (IV.) group regarding median scaling scores (Table 1).

Canine dermatophytosis is a relatively common dermatological disease coused by keratinophilic fungi (*Microsporum sp.* and *Tricophyton mentagraphytes*) (Foil, 1998, Carlotti and Bensignor, 1999). *M. canis* is the involved etiological agent among diseased 12 dogs in this study, as reported previously, (Scott et al,

2001). Face and forelegs are frequently involved for initial infection, as alopecia (expanding circular patch), within erythematous active crusting border together with central clearing and healing (Gross et al., 2005). Follicular papules, pustules, scaling and crusting may all be observed. Besides in case of chronicity in dogs hyperpigmentation is a clinical feature (Gross et al., 2005). In the present study dogs infected with *M. canis* all showed above mentioned clinical signs with special reference to alopecia and hyperpigmentation.

Canine demodicosis, a parasitic skin disease coused by follicular mite of demodex species, and in general by *D. canis*, may be classified as juvenile on set and adult on set forms, wit localized or generalized distribution (Scott et al., 2001, Gross et al., 2005). In the present study among 20 dogs with demodicosis alopecic macules, with nodular lesions were prominent features. The periorbital region, commissures of the mouth, face and forelegs are commonly affected studies (Scott et al, 2001; Gross et al., 2005; Izdebska and Fryderyk, 2011). In this study among 9 dogs with localized demodicosis, 5 of them presented lip fold dermatitis involving the commissures of the mouth. Generalized demodicosis frequently starts with erythematous, alopecic, crusted macules. As chronicty develops, hyperpigmentation, lichenification and scarring develops (Scott et al., 2001; Gross et al., 2005). As to the present authors experience demodicosis cases usually refer to the clinic at a chronic stage, it is usual to observe hyperpigmentation and lichenification. In the present study out of 20 demodectic dogs hyperpigmentation and alopecia were prominent features of the disease, and 11 dogs were diagnosed with adult onset generalized demodicosis as reported previously (Karakurum et al., 2007).

Among scoring results relevant to different groups involved median alopecia, hyperpgimentation and lichenification scores revealed non-significant changes. Regarding median crusting scores there was a statistically significant difference (P<0,001) among demodectic mange group and other groups. Median scaling scores showed statiscally significant differences among groups (between sarcoptic mange group and Malassezia/ Leishmania groups (P<0,001), among Malassezia and Dermatophytosis group (p<0,001), and between Leishmania group and Dermatophytosis/ Demodectic mange groups (p<0,001). Median scores for comedo formation indicated statistical variances between Demodectic mange and all other groups at the level of p<0,001. Interestingly median alopecia and hyperpigmentation scores did not differ between groups, as all two dermatological signs were evident in all of the cases.

To the present authors knowledge a clinical survey neither retrospectively nor prospectively were reported relevant to primary and secondary skin lesions among dogs with infectious dermatoses up to date in Turkey. Besides aforementioned clinical signs were subjected to scoring in different infectious dermatological diseases with special reference to clinico-parasitological view herein. Detailed clinical surveys with larger dog populations will be the purpose of our future studies.

Table 1. Median scoring results of primary/secondary skin lesions among infectious dermatoses of dogs.
Tablo 1. İnfeksiyöz dermatozlu köpeklerde primer/sekunder deri lezyonlarına ait median skorlama sonuçları.

Groups	N	Alopecia	Crusting	Scaling	Hyperpigmentation	Lichenification	Comedo
Sarcoptic mange	18	2.5	1.0^{b}	1.0^{c}	2.0	2.0^{a}	1.0^{b}
Dermatophytosis	14	2.5	1.5^{b}	1.0^{c}	2.0	0.0^{b}	0.5^{b}
Malessezia dermatitis	14	2.0	1.0^{b}	$2.0^{a.b}$	2.0	1.0^{a}	1.0^{b}
Leishmania	12	2.0	1.0^{b}	2.5^{a}	1.0	$1.0^{a.b}$	1.0^{b}
Demodectic mange	20	2.0	2.5^{a}	$1.0^{b.c}$	2.0	1.0^{a}	2.0^{a}
P values		0.141	<0.001	<0.001	0.565	0.002	<0.001

Values referred as median. P values at the table dedicated to results obtained within Kruskal-Wallis test.
$^{a.b.c}$: Different letters at the same coloumn indicated the statistical differences among groups as detected by post hoc Bonferroni corrected Mann-Whitney U test at the level of $P<0.05$.

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